TABLE OF CONTENTS

EXECUTIVE SUMMARY	**1**
INTRODUCTION	**1**
BACKGROUND	**4**
SHORELINE SURVEY/DESCRIPTION OF WATERSHED	**6**
HYDROGRAPHY	**8**
METHODS	**9**
BACTERIOLOGICAL INVESTIGATION AND DATA ANALYSIS	**10**
RESULTS AND DISCUSSION	**11**
CONCLUSIONS	**22**
RECOMMENDATIONS	**23**
LITERATURE CITED	**27**
ACKNOWLEDGMENTS	**27**
APPENDICES	**43**

TABLES

Table 1: Summary of Water Quality Data for the Upper Navesink Estuary (1992 - 1995). 12
Table 2: Summary of Water Quality Data for the Lower Navesink Estuary (1992 - 1995). 13
Table 3: Seasonal Summary of Water Quality Data for the Upper Navesink Estuary (1992 - 1995). 14
Table 4: Seasonal Summary of Water Quality Data for the Lower Navesink Estuary (1992 - 1995). 15
Table 5: Navesink River Estuary Total Coliform Median Data (1992-1995). 21

FIGURES

Figure 2: Land Use Patterns in the Navesink Watershed. 5
Figure 3: Municipal Boundaries, Navesink Estuary Watershed. 6
Figure 4: Direct Discharges to the Navesink River watershed. 7
Figure 5: Indirect Discharges to the Navesink Watershed. 8
Figure 6: Precipitation Inputs (1988-1995). 9
Figure 7: Sampling Locations in the Navesink River Estuary. 10
Figure 8: Navesink River Total Coliform Geometric Mean Values (1992-1995 16
Figure 9: Median Year-round Values for Total and Fecal Coliform. 17
Figure 10: Median Values for Total and Fecal Coliform During Winter and Summer. 18
Figure 11: Total and Fecal Coliform - Percent Exceeding 330 MPN (Total Coliform) and 49 MPN (Fecal Coliform. 19
Figure 12: Proposed Shellfish Classification Changes for the Navesink Estuary. 26

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EXECUTIVE SUMMARY

The last sanitary survey describing this area was completed in December 1993 for the period 1988 through 1992. Since this area is sampled under the Adverse Pollution Condition strategy, a minimum of 15 samples are required for each sampling station. Therefore, this report will include water quality data collected from January 1, 1992, through December 31, 1995. The data collected in this area showed an improvement in water quality for the lower portion of the Navesink River estuary. Therefore, 624 acres, from Oceanic Bridge to the confluence with the Shrewsbury River will be upgraded from Special Restricted to Seasonally Approved. All other classified areas with Area 3 will remain under the current classification.

INTRODUCTION

This report is part of a series of studies having a dual purpose. The primary purpose is to comply with the guidelines of the National Shellfish Sanitation Program (NSSP), as established by the Interstate Shellfish Sanitation Conference (ISSC). The information contained in the growing area reports is also used for the New Jersey State Water Quality Inventory Report (305b), which provides an assessment to Congress every two years of current water quality conditions in the State's major rivers, lakes, estuaries and ocean waters. The reports provide valuable information for the 305(b) report, which describes the waters which are attaining state designated water uses and national clean water goals; the pollution problems identified in surface waters; and the actual or potential sources of pollution.

The secondary purpose is to integrate into this report the findings of the 1990 State Water Quality Inventory Report, which was prepared pursuant to Section 305(b) of the Federal Clean Water Act (P.L. 95-217). The growing area reports utilize relevant information contained in the 305(b) report, since the latter assessments are based on instream monitoring data (temperature, oxygen, pH, total and fecal coliform bacteria, nutrients, solids, ammonia and metals), land-use profiles, drainage basin characteristics and other pollution source information.

From the perspective of the Shellfish Classification Program, the reciprocal use of water quality information from these reports represents two sides of the same coin: the growing area report focuses on the estuary itself, while the 305(b) report describes the watershed that drains to that estuary.

As a brief history, the NSSP developed from public health principles and program controls formulated at the original conference on shellfish sanitation called by the Surgeon General of the United States Public Health Service in 1925. This conference was called after oysters were implicated in causing over 1500 cases of typhoid fever and 150 deaths in

1924. The tripartite cooperative program (federal, state and shellfish industry) has updated the program procedures and guidelines through workshops held periodically until 1977. Because of concern by many states that the NSSP guidelines were not being enforced uniformly, a delegation of state shellfish officials from 22 states met in 1982 in Annapolis, Maryland, and formed the ISSC. The first annual meeting was held in 1983 and continues to meet annually at various locations throughout the United States.

Parts I and II of the NSSP Manual of Operations (USPHS, 1992) set forth the principles and requirements for the sanitary control of shellfish produced and shipped in interstate commerce in the United States. They are used by the Federal Food and Drug Administration (FDA) to evaluate state shellfish sanitation programs. There are five major points on which the state is evaluated by the FDA:

l. The classification of all shellfish growing areas based on actual or potential pollution and their suitability for harvesting and marketing of shellfish for public consumption;

2. The control of the harvesting of shellfish from areas which are classified as restricted, prohibited or otherwise closed;

3. The regulation and supervision of shellfish resource recovery programs;

4. The ability to restrict the harvest of shellfish from areas in a public health emergency; and

5. The prevention of the sale, shipment or possession of shellfish which cannot be identified as being produced in accordance with the NSSP and have the ability to condemn, seize or embargo such shellfish.

The authority to carry out these functions is divided between the Department of Environmental Protection (DEP), the Department of Health and the Department of Law and Public Safety. The Bureau of Marine Water Classification and Analysis (BMWCA) under the authority of N.J.S.A. 58:24 classifies the shellfish growing waters and administers the special resource recovery programs. Regulations delineating the growing areas are promulgated at N.J.A.C. 7:12 and are revised annually. Special Permit rules are also found at N.J.A.C. 7:12 and are revised as necessary.

The Bureau of Shellfisheries in the Division of Fish, Game and Wildlife issues harvesting licenses and leases for shellfish grounds under the Authority of N.J.S.A. 50:2 and N.J.A.C. 7:25. This bureau in conjunction with the BMWCA administers the Hard Clam Relay Program.

The Bureau of Law Enforcement in the DEP and the Division of State Police in the Department of Law and Public Safety enforce the provisions of the statutes and rules mentioned above.

The Department of Health is responsible for the certification of wholesale shellfish establishments and in conjunction with the BMWCA, administers the depuration program. (See Appendix for organization chart).

Emphasis is placed on the sanitary control of shellfish because of the direct relationship between pollution of shellfish growing areas and the transmission of disease to humans. Shellfish-borne infectious diseases are generally transmitted via a fecal-oral route. The pathway is complex and quite circuitous. The cycle usually begins with fecal contamination of the shellfish growing waters. Sources of such contamination are many and varied. Contamination reaches the waterways via runoff and direct discharges.

Clams, oysters and mussels pump large quantities of water through their bodies during normal feeding. During this process the shellfish also concentrate microorganisms (which may include pathogenic microbes), as well as toxic heavy metals and other hazardous chemicals. It is imperative that a system is in place that reduces human health risk by preventing the harvest and marketing of shellfish from contaminated areas.

Accurate classifications of shellfish growing areas are completed through a comprehensive sanitary survey. Complete intensive sanitary surveys are conducted every 12 years with interim narrative evaluations completed on a three year basis. If major changes to the shoreline or bacterial quality occur, then the intensive report is initiated prior to its l2 year schedule. The principal components of the sanitary survey report include:

l. An evaluation of all actual and potential sources of pollution;

2. An evaluation of the hydrography of the area; and

3. An assessment of water quality and hydrology.

This report represents the bureau's assessment of the Navesink River shown in Figure 1 (Shellfish Growing Area 3) using the above-referenced information. It provides a determination of the classification of the shellfish growing waters for this estuary.

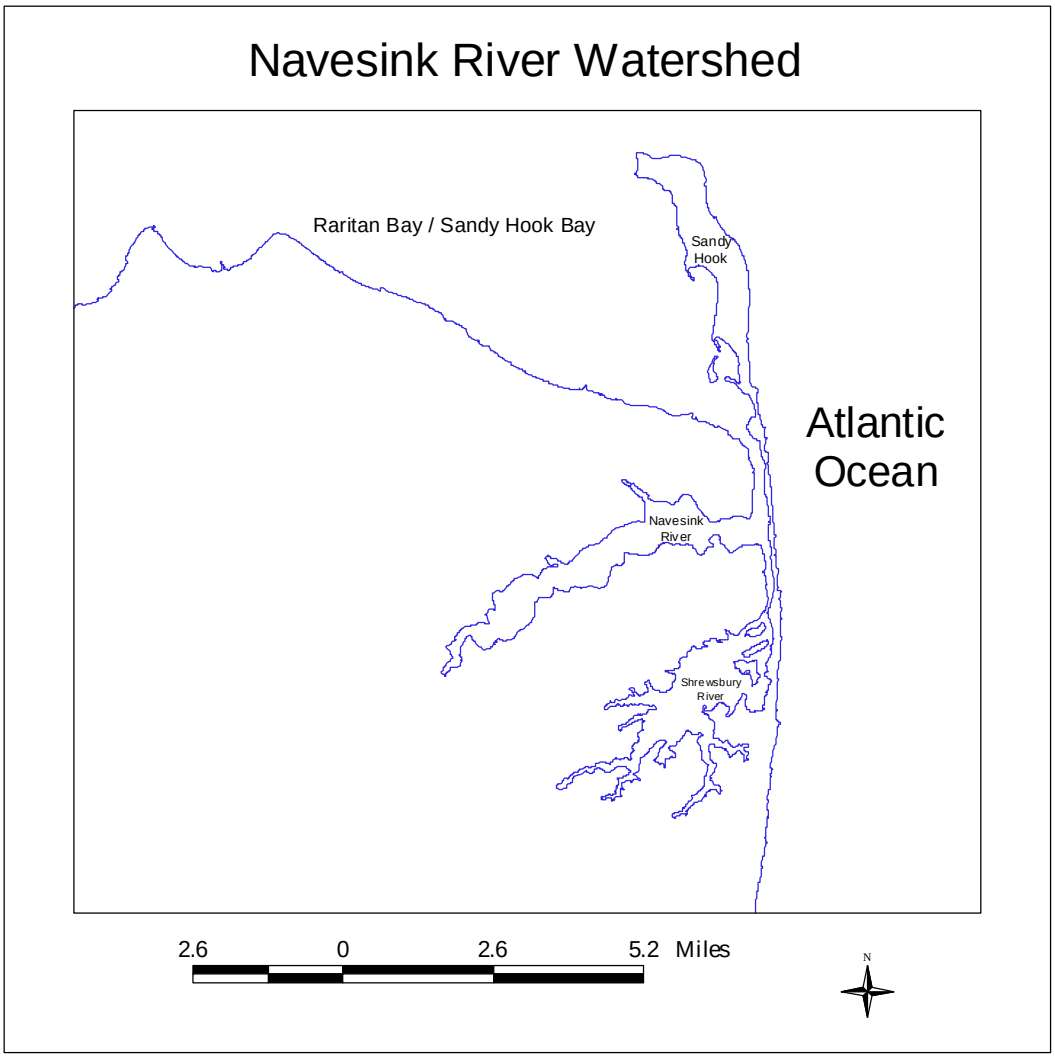


Figure 1: Location Of Growing Area 3, the Navesink River Estuary.

BACKGROUND

The Navesink River is an estuary of the Raritan-Sandy Hook Bay complex which joins the Shrewsbury River before entering the Atlantic Ocean through Sandy Hook Bay (Shellfish Growing Water Classification Chart 2, Appendix 1). The Navesink watershed drains 95 square miles of urban/suburban residential development and agricultural lands**.** Figure 2 demonstrates that land use patterns in the Navesink watershed include significant agricultural uses, primarily in the headwaters areas, and urban/suburban development, primarily in the areas bordering the estuary.

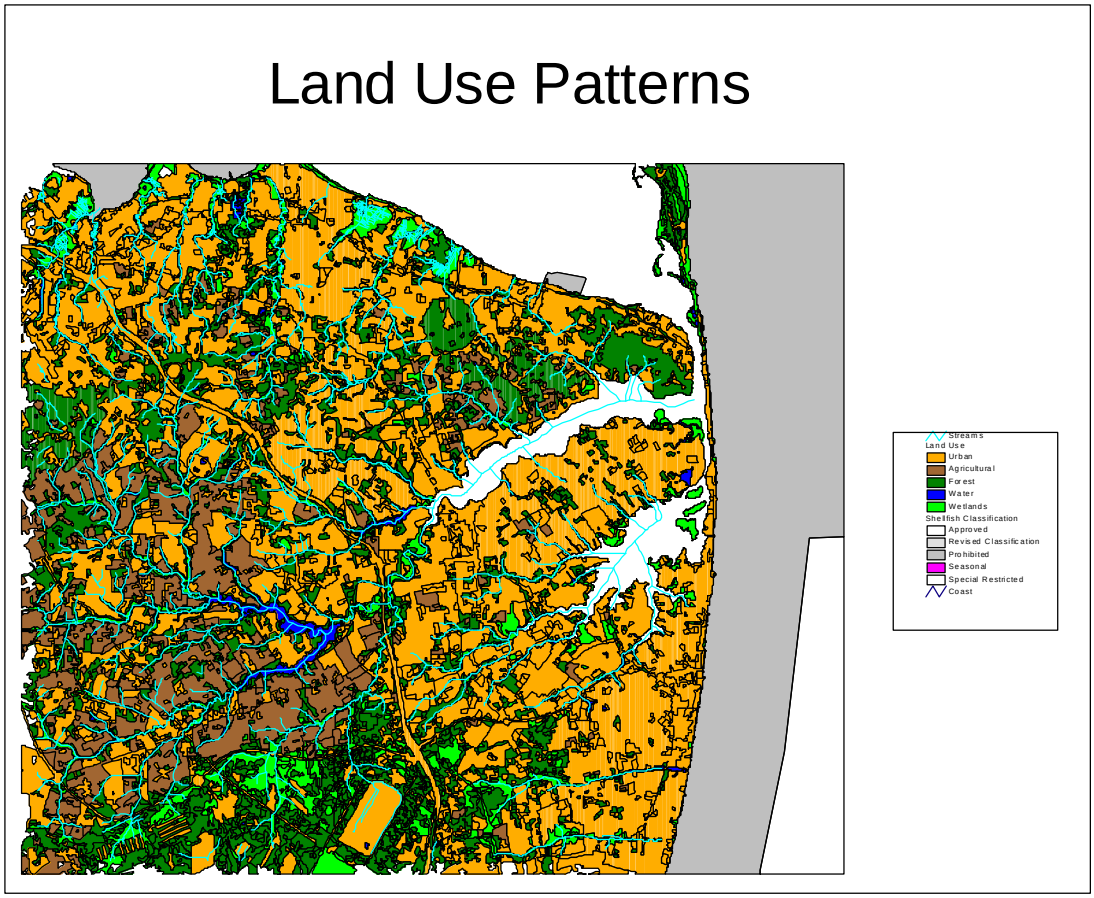


Figure 2: Land Use Patterns in the Navesink Watershed. Note that urban and suburban land uses predominate in the areas closest to the estuary, while agricultural land uses predominate in upgradient areas.

The Navesink estuary contains 2,290 acres of shellfish growing waters, which support substantial hard clam (Mercenaria mercenaria) and soft clam (Mya arenaria) populations. Shellfish densities were estimated by the Division of Fish, Game & Wildlife (Bureau of Shellfisheries), based on field measurements taken at 52 stations throughout the Navesink River. The Navesink, together with the adjoining Shrewsbury River, provide for almost the entire soft clam fishery in New Jersey. At one time, soft clams were harvested under special permits for depuration. A hard clam relay program was started in the Navesink (as well as the Shrewsbury and Sandy Hook Bay) in 1983, with the harvested clams being transported to clean (*Approved*) waters in Barnegat Bay, and Little Egg Harbor, for a period of 30 days. Presently (1996), in addition to the relay program, hard clam depuration plants are in operation in Sea Bright and Highlands.

Since 1986, the Department has been engaged in a cooperative program with the New Jersey Department of Agriculture, the United States Environmental Protection Agency, the United States Department of Agriculture - Soil Conservation Service, and Monmouth

County to identify and implement various best management practices controls on nonpoint sources of pollutants in the watershed. These efforts resulted in a recommendation by the Department in August 1996 to upgrade the Marine Water Shellfish Classification in the lower Navisink to "*Seasonally Approved*."

SHORELINE SURVEY/DESCRIPTION OF WATERSHED

The Navesink watershed includes all or a portion of the municipalities shown in Figure 3.

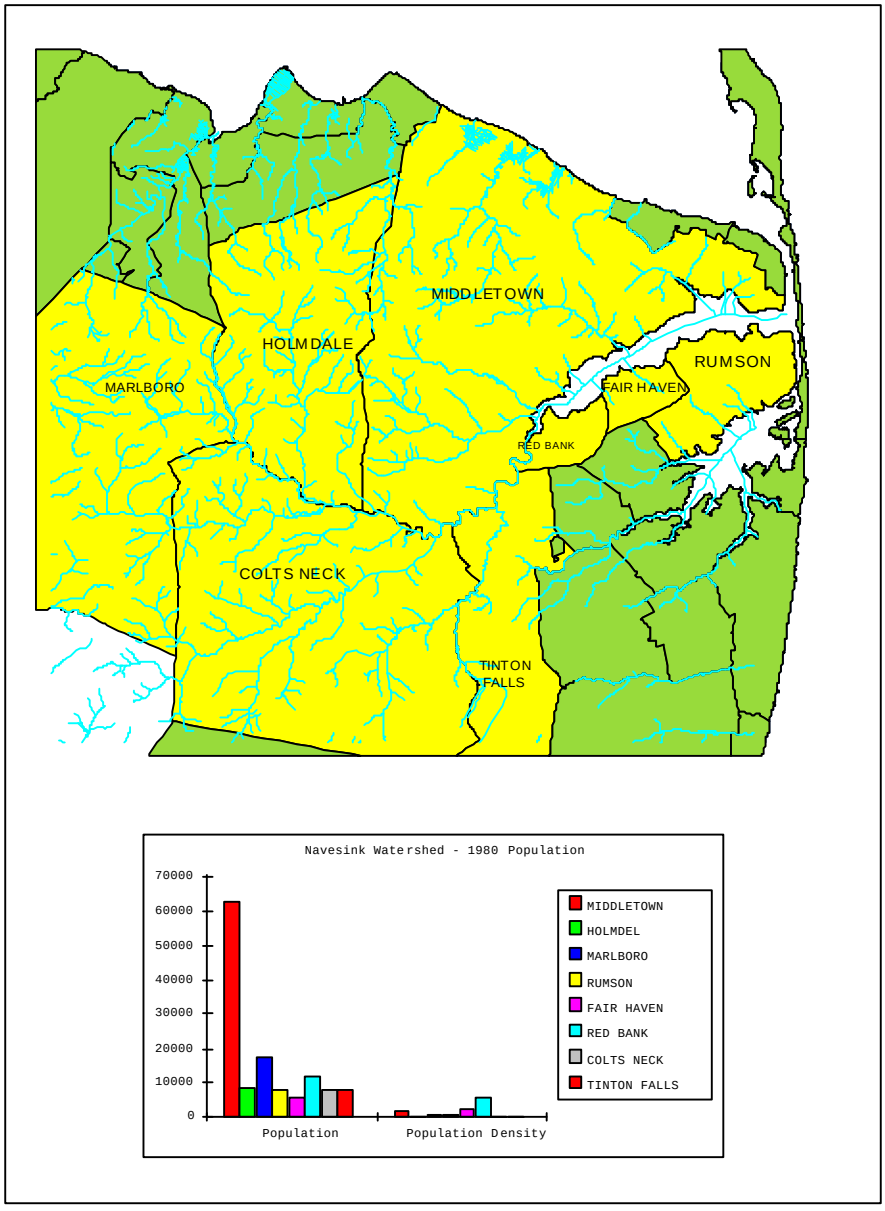


Figure 3: Municipal Boundaries, Navesink Estuary Watershed.

Direct discharges to the waterbody are shown in Figure 4.

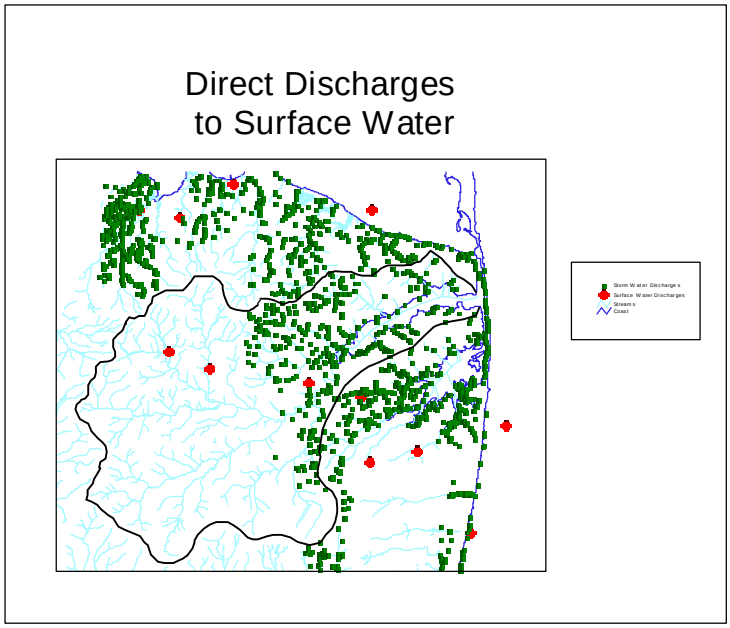


Figure 4: Direct Discharges to the Navesink River watershed. Permitted point source discharges are shown in red, while storm water discharges are shown in green.

Permitted discharges from treatment facilities are generally located in upstream areas. Wastewater generated in the downstream area is treated and discharged to the Atlantic Ocean. Stormwater discharges are concentrated in the areas adjacent to the estuary, reflecting the urban/suburban land use and the related impervious surfaces found in developed areas.

Known contaminated sites and sites listed by the toxic release inventory are shown in Figure 5.

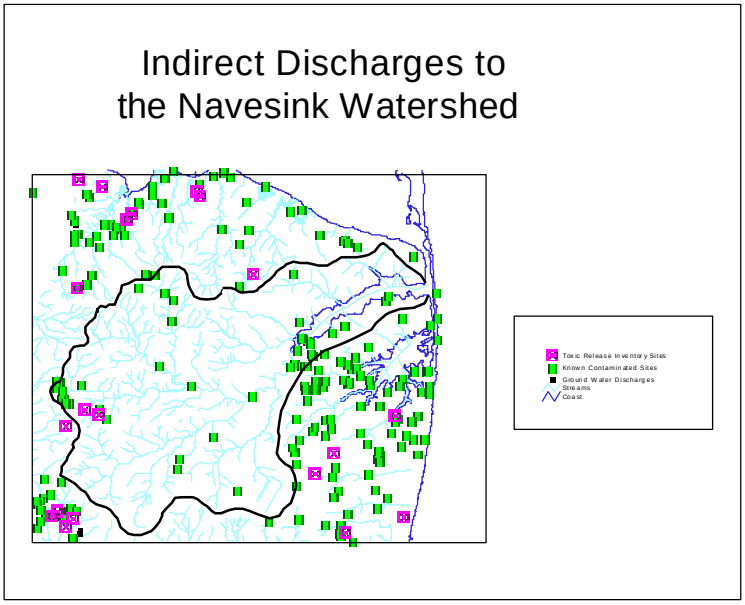


Figure 5: Indirect Discharges to the Navesink Watershed. Toxic Release Inventory sites are shown in purple. Known contaminated sites are shown in green. Ground water discharges are shown in black. Note that many of the indirect discharges are located in upstream areas rather than immediately adjacent to the estuary.

There have been no significant changes in the watershed since the 1993 Growing Area Report.

HYDROGRAPHY

A detailed hydrography report was completed for the 1993 Growing Area Report. Precipitation inputs to the area for the period 1988 through 1995 are shown in Figure 6. There have been no significant changes in hydrography since 1993.

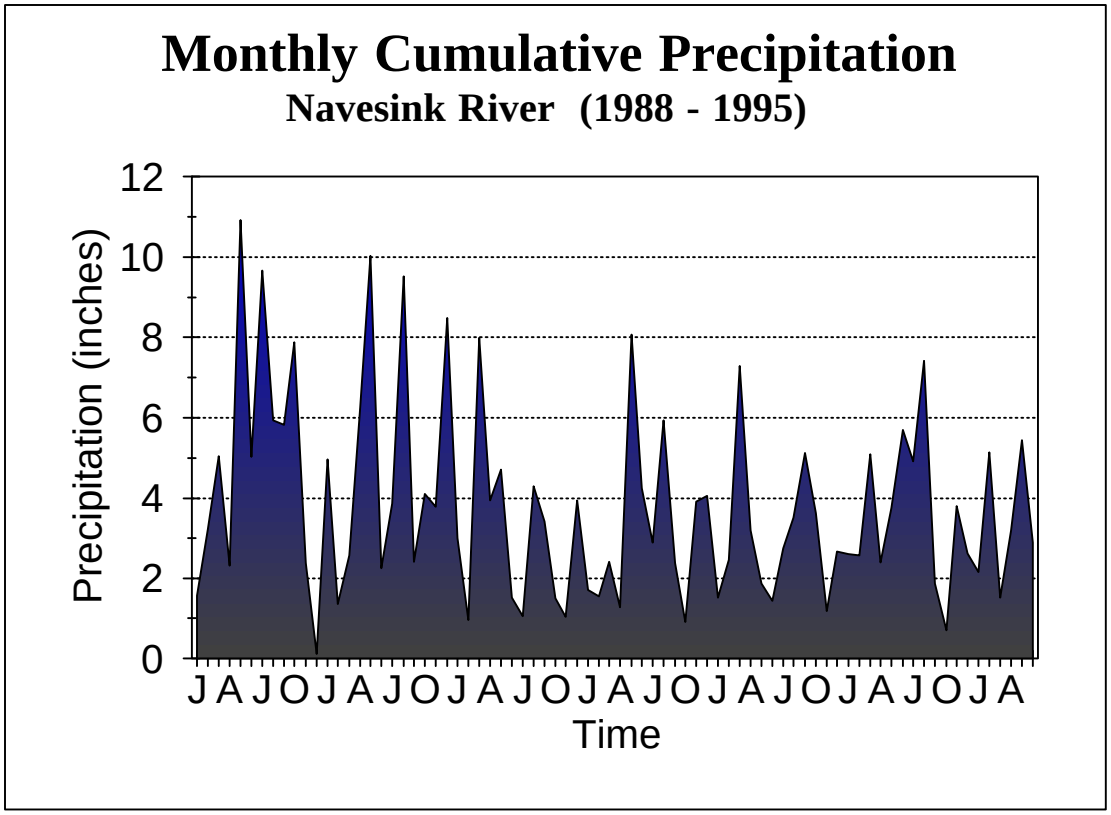


Figure 6: Precipitation Inputs (1988-1995).

METHODS

Water sampling was performed in accordance with the Field Procedures Manual (NJDEP, 1987).

Approximately 1400 water samples were collected for total and fecal coliform bacteria between 1992 and 1995 and analyzed by the three tube MPN method according to APHA (1970). Figure 1 shows the Shellfish Growing Water Quality monitoring stations in the Navesink River. Approximately forty-five stations are monitored during each year.

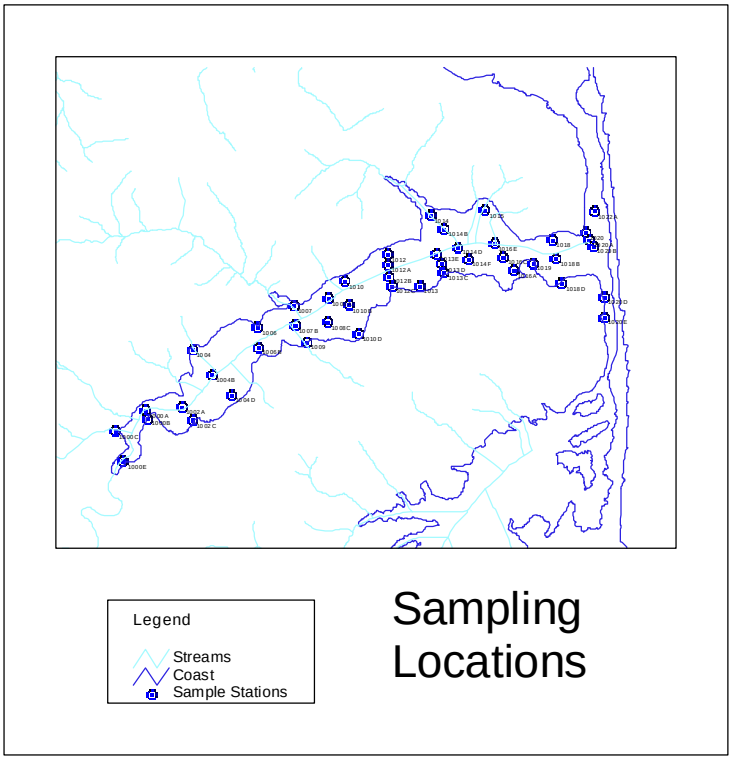


Figure 7: Sampling Locations in the Navesink River Estuary. Bacteriological data obtained from samples collected at these sites are used to classify shellfish waters in the estuary.

Water quality sampling, shoreline and watershed surveys were conducted in accordance with the NSSP Manual of Operations, Part I, Appendix B (USPHS, 1992).

Data management and analysis was accomplished through Storet. Mapping of pollution data was performed with the NJDEP, Geographic and Statistical Analysis Unit, Geographic Information System (GIS:ARCVIEW).

BACTERIOLOGICAL INVESTIGATION AND DATA ANALYSIS

The water quality of each growing area must be evaluated before an area can be classified as *Approved, Seasonally Approved, Special Restricted,* or *Seasonal Special Restricted*. Criteria for bacterial acceptability of shellfish growing waters are provided in Part I of National Shellfish Sanitation Program Manual of Operations - 1992 Revision. Each shellfish producing state is directed to adopt either the total coliform criterion, or the fecal coliform criterion. While New Jersey bases its growing water classifications on the total coliform criterion, it does make corresponding fecal coliform determinations for each

sampling station, these data are viewed as adjunct information and are not directly used for classification. The State Shellfish Control Authority also has the option of choosing one of the two water monitoring sampling strategies for each growing area.

The Adverse Pollution Condition Strategy requires that a minimum of five samples be collected each year under conditions that have historically resulted in elevated coliforms in the particular growing area. The results must be evaluated by adding the individual station sample results to the preexisting bacteriological sampling results to constitute a data set of at least 15 samples for each station. The adverse pollution conditions usually are related to tide, and rainfall, but could be from a point source of pollution or variation could occur during a specific time of the year. Under this strategy, for *Approved* waters, the total coliform median or geometric mean MPN of the water shall not exceed 70 per 100 mL and not more than 10 percent of the samples exceed an MPN of 330 per 100 mL for the 3-tube decimal dilution test. For *Special Restricted* waters, the total coliform median or geometric mean MPN of the water shall not exceed 700 per 100 mL and not more than 10 percent of the samples exceed an MPN of 3300 per 100 mL for the 3-tube decimal dilution test. Areas to be Approved under the Seasonal classification must be sampled and meet the criterion during the time of the year that it is approved for the harvest of shellfish.

The Systematic Random Sampling strategy requires that a random sampling plan be in place before field sampling begins and can only be used in areas that are not affected by point sources of contamination. A minimum of six samples per station are to be collected each year and added to database to obtain a sample size of 30 for statistical analysis. The bacteriological quality of every sampling station in *Approved* areas shall have a total coliform median or geometric mean MPN not exceeding 70 per 100 mL and the estimated 90th percentile shall not exceed an MPN of 330 per 100 mL. For *Special Restricted* areas, the bacteriological quality shall not exceed a total coliform median or geometric mean MPN of 700 per 100 mL and the estimated 90th percentile shall not exceed an MPN of 3,300 per 100 mL.

The Navesink River is sampled under the Adverse Pollution Condition strategy described above.

RESULTS AND DISCUSSION

For the purpose of determining the shellfish growing water classification of the Navesink River, a summary of the water quality data collected from 1992-1995 is presented in Tables 1 and 2. These data were collected during the period following implementation of Best Management Practices (BMP's) to control nonpoint source pollution in the Navesink River watershed.

Table 1: Summary of Water Quality Data for the Upper Navesink Estuary (1992 - 1995). The water quality standard for *Approved* waters is: maximum median value for Total Coliform: 70 MPN, with no more than 10% in excess of 330 MPN; for Fecal Coliform: 14 MPN, with no more than 10% in excess of 49 MPN. New Jersey uses the Total Coliform standard. Water quality in the upper estuary generally does not comply with this standard. (Shaded data is not in compliance.)

Station	Total Coliform Median	Total Coliform percent >330	Fecal Coliform Median	Fecal Coliform percent >49
1000A	460.0	72.5	93.0	60.0
1000B	240.0	47.1	150.0	64.7
1000C	240.0	43.8	84.0	56.3
1000E	2400.0	80.5	150.0	70.7
1002A	240.0	42.5	43.0	47.5
1002C	460.0	56.1	93.0	68.3
1004	93.0	15.4	23.0	26.3
1004B	93.0	27.5	23.0	30.0
1004D	240.0	46.3	43.0	48.8
1006	43.0	26.8	15.0	34.1
1006B	93.0	35.7	21.5	31.0
1007	93.0	29.3	23.0	34.1
1007B	93.0	23.8	23.0	28.6
1008A	19.0	12.5	9.1	0.0
1008C	23.0	11.8	9.1	5.9
1009	59.0	31.0	19.0	28.6
1010	43.0	12.2	23.0	22.0
1010B	35.5	9.5	9.1	9.5
1010D	39.5	16.7	13.0	19.0
1012	23.0	7.3	9.1	9.8
1012A	23.0	12.2	9.1	14.6
1012B	15.0	0.0	3.6	5.9
1012C	15.0	5.9	9.1	0.0

Table 2: Summary of Water Quality Data for the Lower Navesink Estuary (1992 - 1995). The water quality standard for *Approved* waters is: maximum median value for Total Coliform: 70 MPN, with no more than 10% in excess of 330 MPN; for Fecal Coliform: 14 MPN, with no more than 10% in excess of 49 MPN. New Jersey uses the Total Coliform standard. Water quality in the lower estuary generally complies with this standard. (Shaded data is not in compliance.)

Station	Total Coliform Median	Total Coliform percent >330	Fecal Coliform Median	Fecal Coliform percent >49
1013	15.0	5.9	7.2	0.0
1013C	17.5	9.5	9.1	4.8
1013D	15.0	0.0	3.6	0.0
1013E	9.1	0.0	3.6	0.0
1014	21.0	14.6	9.1	22.0
1014B	19.0	0.0	9.1	6.3
1014D	23.0	4.8	7.3	7.1
1014F	9.1	0.0	7.3	0.0
1015	15.0	6.3	8.2	6.3
1016A	23.0	11.9	3.6	9.5
1016C	9.1	0.0	9.1	5.9
1016E	9.1	0.0	3.6	0.0
1018	19.0	0.0	8.2	6.3
1018B	22.0	4.8	9.1	7.1
1018D	15.0	4.8	3.6	4.8
1019	3.6	5.9	3.6	0.0
1020	9.1	0.0	9.1	0.0
1020A	43.0	8.0	9.1	8.0
1020B	22.0	11.9	9.1	11.9
1020D	15.0	7.1	7.3	9.5
1020E	11.0	5.9	9.1	0.0
1022A	21.0	7.1	3.6	4.8

Note that downstream of sampling station transect 1013, located at the Oceanic Bridge, the water quality complies with the water quality standard year-round, except for three stations which minimally exceed the water quality standard: station 1014, located at the mouth of Claypit Creek, station 1016A, located near the shoreline, and station 1020B, located at the junction with the Shrewsbury River. Table 3 below compares the year-round data with the seasonal data for the upper Navesink River estuary. There is no significant seasonal variability in the upper estuary.

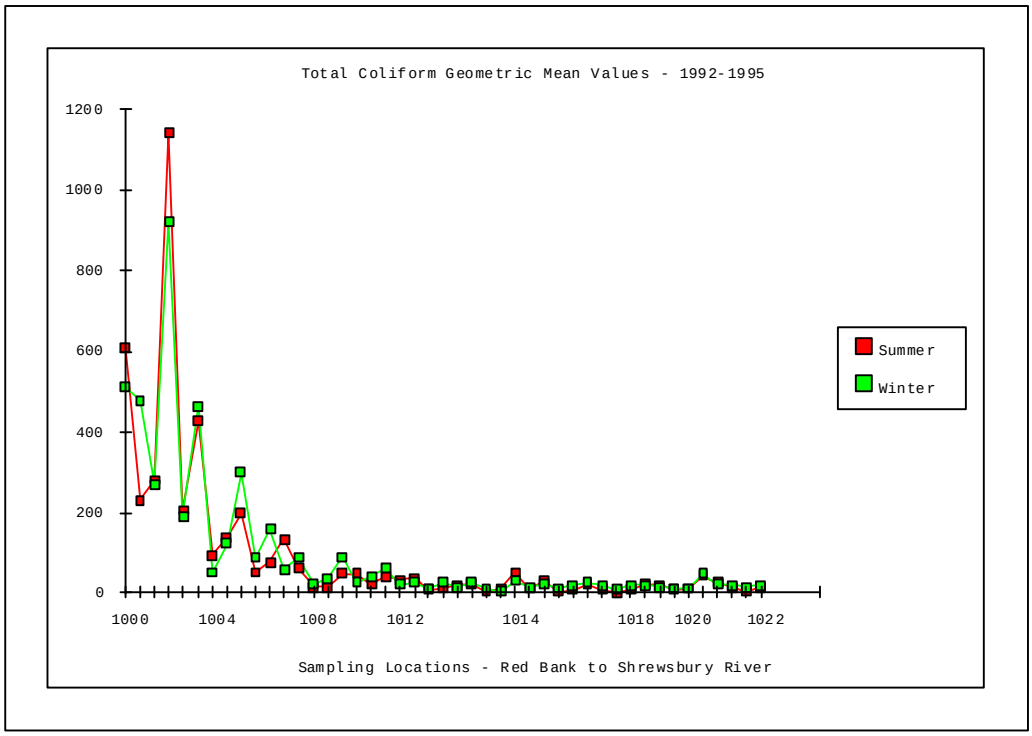
Table 3: Seasonal Summary of Water Quality Data for the Upper Navesink Estuary (1992 - 1995). The water quality standard for *Approved* waters is: maximum median value for Total Coliform: 70 MPN, with no more than 10% in excess of 330 MPN. Water quality in the upper estuary generally does not comply with this standard. (Shaded data is not in compliance.)

Station	Total Coliform Median (year-round)	Total Coliform Median (summer)	Total Coliform Median (winter)	Total Coliform percent >330 (year-round)	Total Coliform percent >330 (summer)	Total Coliform percent >330 (winter)
1000A	460.0	780.0	460.0	72.5	81.3	66.7
1000B	240.0	240.0	780.0	47.1	20.0	58.3
1000C	240.0	240.0	240.0	43.8	40.0	45.5
1000E	2400.0	2400.0	1100.0	80.5	93.8	72.0
1002A	240.0	350.0	240.0	42.5	50.0	37.5
1002C	460.0	460.0	460.0	56.1	62.5	52.0
1004	93.0	93.0	75.0	15.4	18.8	13.0
1004B	93.0	93.0	121.5	27.5	31.3	25.0
1004D	240.0	93.0	460.0	46.3	37.5	52.0
1006	43.0	33.0	93.0	26.8	18.8	32.0
1006B	93.0	43.0	195.0	35.7	18.8	46.2
1007	93.0	93.0	93.0	29.3	37.5	24.0
1007B	93.0	68.0	121.5	23.8	18.8	26.9
1008A	19.0	23.0	14.0	12.5	0.0	18.2
1008C	23.0	23.0	33.0	11.8	0.0	16.7
1009	59.0	43.0	166.5	31.0	18.8	38.5
1010	43.0	43.0	23.0	12.2	18.8	8.0
1010B	35.5	23.0	43.0	9.5	6.3	11.5
1010D	39.5	29.0	39.5	16.7	12.5	19.2
1012	23.0	33.0	23.0	7.3	12.5	4.0
1012A	23.0	33.0	23.0	12.2	12.5	12.0
1012B	15.0	15.0	18.0	0.0	0.0	0.0
1012C	15.0	23.0	15.0	5.9	0.0	8.3

Table 4: Seasonal Summary of Water Quality Data for the Lower Navesink Estuary (1992 - 1995). The water quality standard for *Approved* waters is: maximum median value for Total Coliform: 70 MPN, with no more than 10% in excess of 330 MPN. The water quality standard applies during the season for which the water is *Approved*. Water quality in the lower estuary generally complies with this standard. At most stations, water quality was better during the winter. (Shaded data is not in compliance.)

Station	Total Coliform Median (year-round)	Total Coliform Median (summer)	Total Coliform Median (winter)	Total Coliform percent >330 (year-round)	Total Coliform percent >330 (summer)	Total Coliform percent >330 (winter)
1013	15.0	15.0	12.1	5.9	0.0	8.3
1013C	17.5	17.5	17.5	9.5	6.3	11.5
1013D	15.0	7.3	15.0	0.0	0.0	0.0
1013E	9.1	15.0	6.4	0.0	0.0	0.0
1014	21.0	48.0	15.0	14.6	12.5	16.0
1014B	19.0	9.1	23.0	0.0	0.0	0.0
1014D	23.0	33.0	23.0	4.8	6.3	3.8
1014F	9.1	9.1	15.0	0.0	0.0	0.0
1015	15.0	7.3	23.0	6.3	0.0	9.1
1016A	23.0	15.0	23.0	11.9	12.5	11.5
1016C	9.1	9.1	9.1	0.0	0.0	0.0
1016E	9.1	3.6	9.1	0.0	0.0	0.0
1018	19.0	15.0	23.0	0.0	0.0	0.0
1018B	22.0	23.0	18.0	4.8	6.3	3.8
1018D	15.0	12.1	15.0	4.8	12.5	0.0
1019	3.6	3.6	9.3	5.9	0.0	8.3
1020	9.1	9.1	14.6	0.0	0.0	0.0
1020A	43.0	23.0	68.0	8.0	18.2	0.0
1020B	22.0	22.0	21.5	11.9	12.5	11.5
1020D	15.0	9.1	18.0	7.1	12.5	3.8
1020E	11.0	9.1	18.5	5.9	0.0	8.3
1022A	21.0	14.6	23.0	7.1	12.5	3.8

Figure 8 provides a graphical representation of the total coliform geometric mean values which correspond to the sampling locations from Red Bank to the confluence of the Navesink River with the Shrewsbury River. The total coliform concentration at sampling locations in the upper portion of the Navesink consistently exceeds the standard of 70 colonies/100 mL for approved waters, while the lower reach, downstream of Oceanic Bridge consistently meets the approved standard in the winter months. Those sampling locations which consistently exceed the approved standard are shown in red on the map.



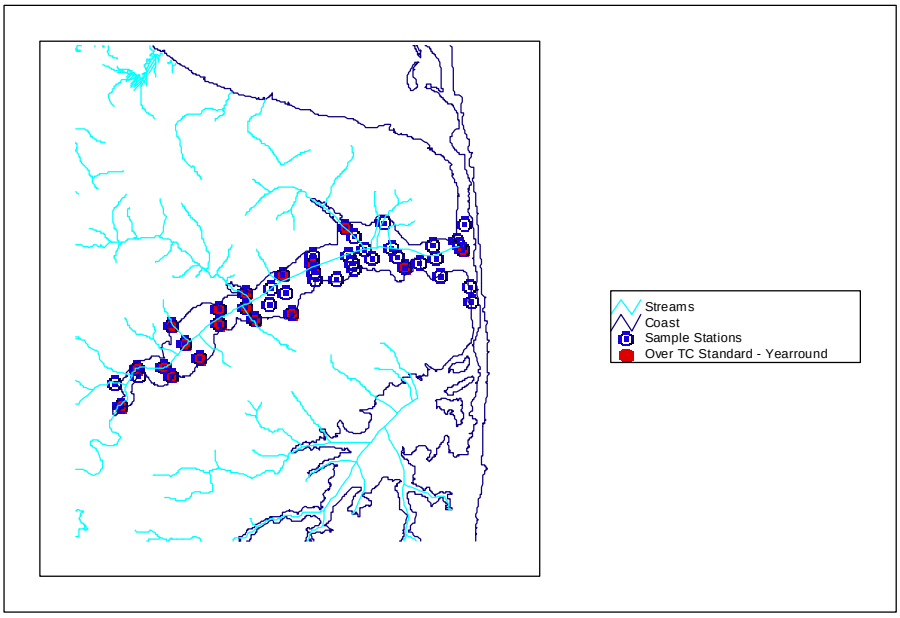


Figure 8: Navesink River Total Coliform Geometric Mean Values (1992-1995).
The *Approved* standard is consistently violated in the upper portion of the estuary. Sampling locations which consistently violate the *Approved* standard are shown in red.

Figures 9, 10, and 11 provide a graphical representation of the total and fecal coliform values (medians and percentages). The X-axis is organized by monitoring site location, from the upstream stations (1000 series) to the downstream stations (1022 series).

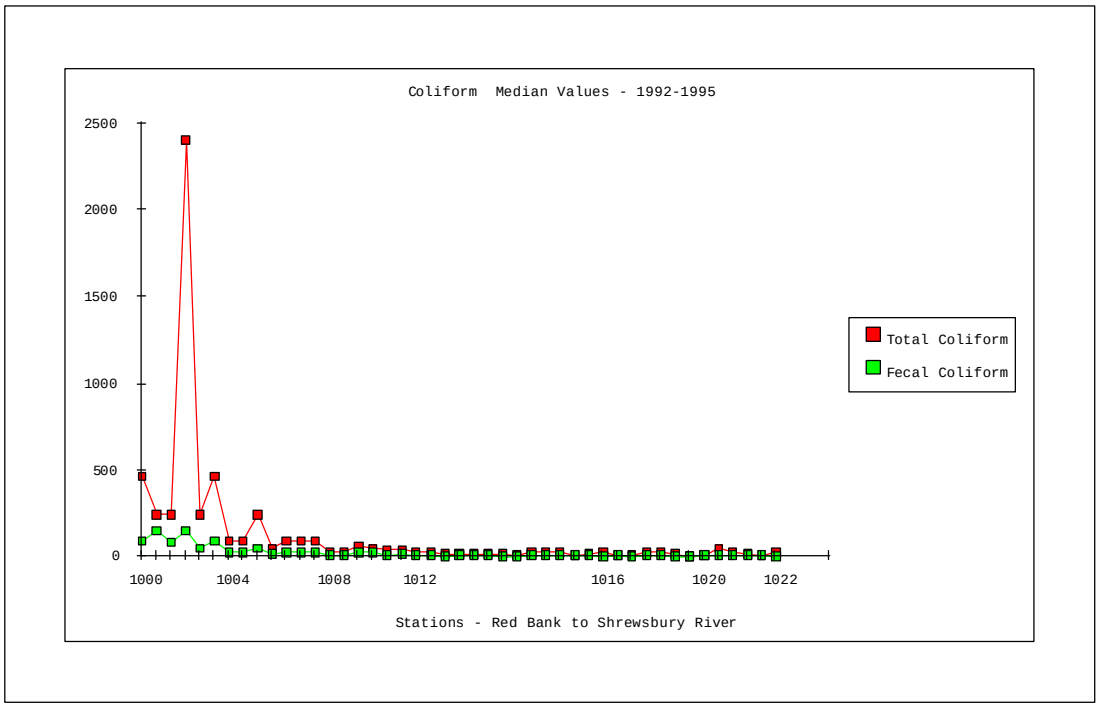


Figure 9: Median Year-round Values for Total and Fecal Coliform. The total coliform water quality standard for *Approved* waters is 70 MPN, while the fecal water quality standard for *Approved* waters is 14 MPN. This standard is frequently violated in the waters upstream of the Oceanic Bridge (approximate location is at the 1013 sampling station series.)

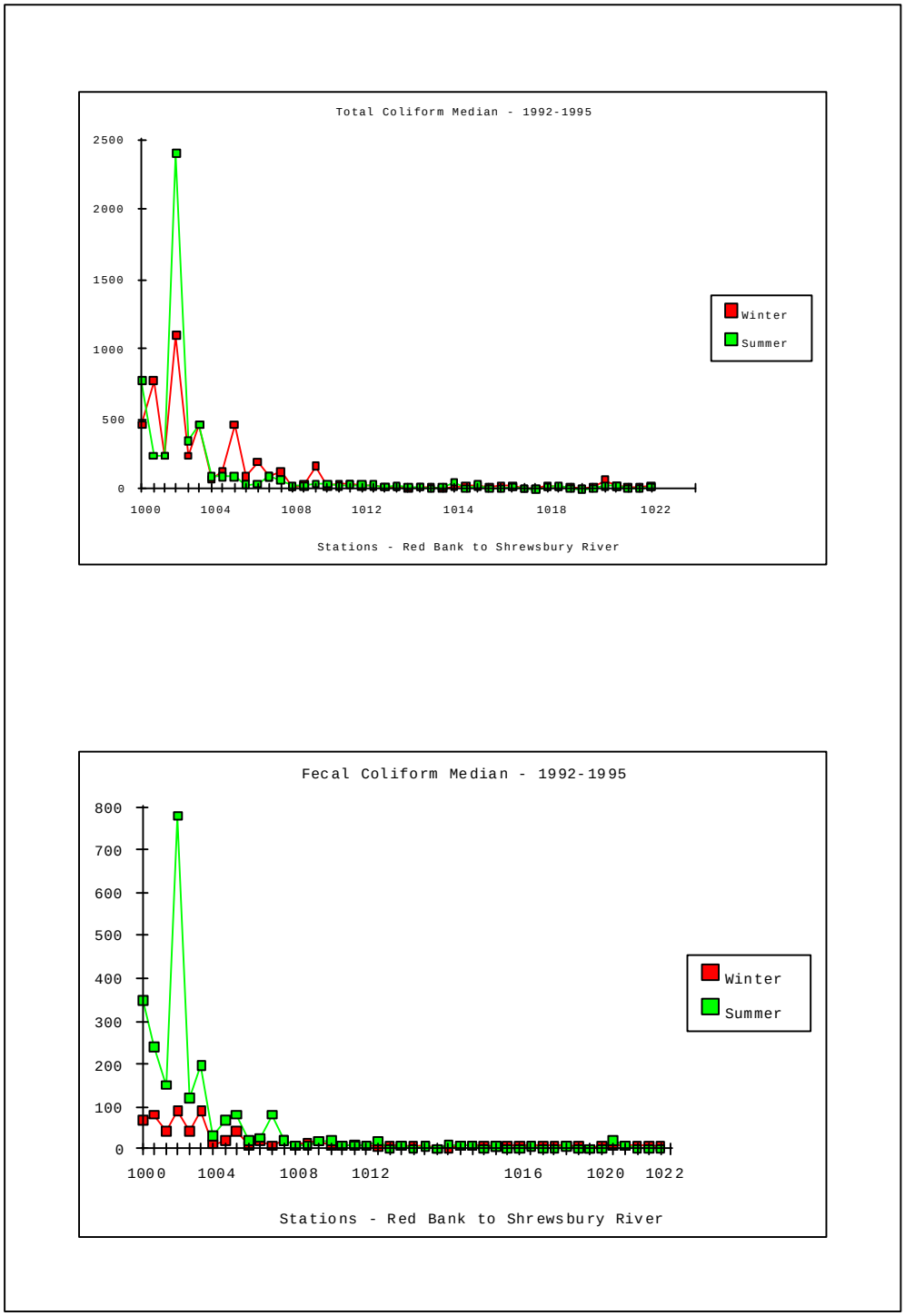


Figure 10: Median Values for Total and Fecal Coliform During Winter and Summer. The total coliform water quality standard for *Approved* waters is 70 MPN, while the fecal water quality standard for *Approved* waters is 14 MPN. This standard is frequently violated in the waters upstream of the Oceanic Bridge (approximate location is at the 1013 sampling station series.)

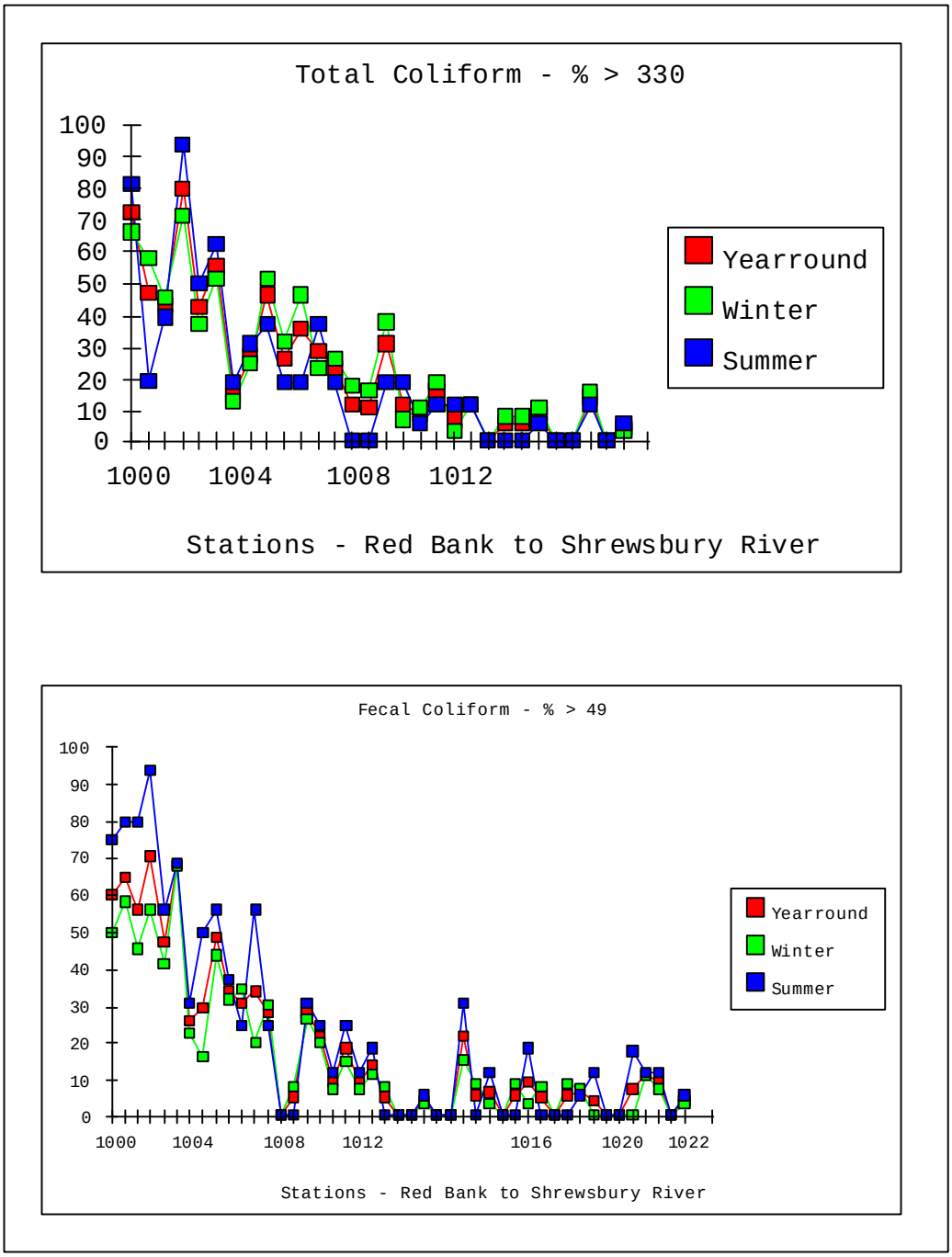


Figure 11: Total and Fecal Coliform - Percent Exceeding 330 MPN (Total Coliform) and 49 MPN (Fecal Coliform. The standard for *Approved* waters states that no more than 10% of the samples may be above 330 MPN for total coliform or 49 MPN for fecal coliform.

The four upstream stations (1000A-1000E), in the Red Bank area exhibit the worst water quality. This upstream segment (50 acres) of the Navesink River has the highest coliform levels and sometimes exceeds its current *Special Restricted* classification. In 1987, administrative changes in New Jersey's shellfish program resulted in 400 acres of the Navesink River, at Red Bank, being reclassified from *Prohibited* to *Special Restricted*, although water quality had not changed (Scro, 1990). Recognizing this, the Bureau of Marine Water Classification and Analysis has closely monitored this area. The findings of the present study indicate that coliform concentrations for the four stations located in the 50 acres upstream of the Cooper Street Bridge analysis should consist of the four tube dilution protocol.

Stations 1002A-1007B, between the upstream segment and McClees Creek (1170 acres), meet the standards for *Special Restricted* waters.

Stations 1008A-1013D, between McClees Creek and the Oceanic Bridge (550 acres), come close to meeting the standards for *Approved* waters. These stations exceed the percent standard for total and fecal coliform, but meet the standard for the median value.

Stations 1013E-1022A, located in the lower 1/3 of the Navesink, between the Oceanic Bridge and the mouth of the river (520 acres), meet the standards for *Approved* shellfish waters, with the exception of three (out of a total of 18) stations: 1014, which receive drainage from Claypit Creek; 1016A, which is located adjacent to the shoreline and has sporadic high values unrelated to preceding rainfall, seasonality, or tidal stage; and 1020B, which is influenced by waters from the Shrewsbury River. These stations, however, only minimally exceed the *Approved* water standards as follows: station 1014 (total coliform percent, 15; fecal coliform percent, 22); station 1016A (total coliform percent, 12); and station 1020B (total coliform percent, 12; fecal coliform percent, 12).

These data show that most of the Navesink River (the grouping of stations from the 1000 series through 1022A) meet the *Special Restricted* standards. The stations in the downstream segment of the river (series 1013 through 1022A) consistently fall into the *Approved* category.

Marine waters are sampled regularly for marine biotoxins by personnel from the Bureau of Water Monitoring. The data are summarized in annual reports published by the Department. In the event of elevated levels, additional samples are obtained for verification.

In addition, the bureau's microbiology laboratory has been conducting a project initiated to evaluate male-specific (F+) coliphage viruses as potential indicators of fecal contamination, especially human enteric viruses in New Jersey coastal waters and shellfish. Estuarine areas influenced by point and nonpoint sources of human and animal waste, including locations in the Navesink were sampled and analyzed for coliphage viruses. The results of samples collected from these locations showed that no human enteric viruses were present. The coliphage data for the Navesink River serves as an additional indicator

of the good sanitary quality of the shellfish and shellfish waters in the lower Navesink estuary.

Statistical analysis (t-test) of shellfish growing water quality data, from 1992 through 1995, indicates that tide does not have a statistically significant influence on coliform values in the Navesink River.

Correlation analysis of shellfish growing water quality data shows a weak relationship between rainfall occurring 1-2 days prior to sampling (but not on the day of sampling) and elevated total coliform concentrations, at 4 of 45 stations in the Navesink River. Of the 45 stations, only 1, between the Oceanic Bridge and the mouth of the river, showed a relationship to rainfall occurring on the date of sampling. However, when dry weather data (less than 0.1 inch of precipitation during the 72 hours preceding sample collection) are compared to wet weather data (more than 0.1 inch of precipitation during the 72 hours preceding sample collection), it appears that two distinctly different processes affect the estuary. (See Table 5 below.) In the upper estuary (sample series 1000-1006), water quality appears to be adversely affected by precipitation, indicating that non-point sources are likely to significantly affect water quality in these areas. Conversely, water quality at stations 1004D, 1007, and 1014 appear to be significantly adversely impacted by dry weather. Station 1004D is adjacent to several stormwater discharges, station 1007 is at the mouth of McClees Creek, and station 1014 is at the mouth of Claypit Creek. These areas should be further investigated to determine if an unpermitted dry weather discharge is adversely affecting water quality.

Table 5: Navesink River Estuary Total Coliform Median Data (1992-1995).

Sampling Station	Total Coliform Wet Weather	Total Coliform Dry Weather
1000A	1100	460
1000E	2400	460
1002A	240	93
1004	93	59
1004B	121	93
1006	68	41
1006B	240	40
1004D	240	460
1007	93	242
1014	15	84
1014D	23	93

The analysis of total coliform indicates that summer season has the greatest adverse impact on the water quality of the Navesink River. This can be seen in the separate analyses of season and of rainfall (for both medians and percentages), as well as the combined influences of season and rainfall. The worst water quality (i.e., those stations exceeding th*e Approved* water criteria) was exhibited during the summer after rainfall in

the upper segment of the Navesink River. During the winter, and after rainfall, the middle and lower segments of the river, east of McClees Creek, meet the *Approved* shellfish water quality criteria.

CONCLUSIONS

1. Shellfish water quality in the Navesink River has continued to improve since the 1993 report. As a result, for the first time in 25 years the potential now exists for realizing the long-term goal of improving water quality in the Navesink River to the point where unrestricted shellfish harvesting can be permitted in the near future. These improvements are a direct result of the successful reduction of nonpoint source loadings from coastal development, agricultural waste and marina and boating-related contamination in the Navesink watershed.

2. Since 1981, a major inter-agency initiative involving federal, state, county and private institutions, and costing several million dollars, has been underway to reduce nonpoint source bacterial pollution of the Navesink estuary. A comprehensive, coordinated management plan was implemented in 1986 to reduce these bacterial source loadings to the estuary, in order to restore recreational and commercial shellfish harvesting. The NJDEP (Bureau of Marine Water Classification & Analysis, Bureau of Shellfisheries, Bureau of Land and Water Planning and Land Use Regulation) has continued to successfully carry out a joint project review strategy to "red-flag" coastal development applications (CAFRA and Waterfront Development permits) for individual docks, marinas and multi-unit development projects in the Navesink watershed. Proposed projects considered for approval are scrutinized to assure that nonpoint source Best Management Practices (BMP's) were incorporated in the design plan.

3. A comprehensive shellfish growing water ambient monitoring program, conducted by the NJDEP Bureau of Marine Water Classification & Analysis (Division of Science & Research, Water Monitoring Management Program), provided the basis for measuring the response of the Navesink River to the nonpoint source pollution management practices implemented. This bureau's coastal ambient monitoring program, which collects approximately 18,000 water samples year-round at 4000 estuarine stations statewide (from the Raritan Bay to the Delaware Bay), is the only comprehensive year-round coastal monitoring program in New Jersey.

RECOMMENDATIONS

1. Approximately 624 acres of shellfish growing waters in the Navesink, east of Oceanic Bridge, will be upgraded to the ***Seasonally Approved*** classification. The NJDEP announced this upgrade on August 19, 1996, to become effective upon adoption of revised shellfish classifications. The projected adoption date is January 1, 1997.

   This recommendation would require modification of N.J.A.C. 7:12-3.2(a)3 and N.J.A.C. 7:12-4.1(a)1 as follows:

   3.2(a) The following shellfish growing waters are classified as Special Restricted:

   1. - 2. (No change)

   3. All of the Navesink River and tributaries <u>west of the Oceanic Bridge</u>.

   4. - 19. (No change)

   4.1 (a) The following shellfish growing waters designated on the charts referred to in N.J.A.C. 7:12-1.1 shall be Special Restricted for the harvest of shellfish from May 1 through October 31 yearly and Approved for the harvest of shellfish from November 1 through April 30 yearly:

   <u>1. Navesink River: Seasonally Approved (Special Restricted May 1 through October 31 yearly; Approved November 1 through April 30 yearly): - All those waters contained within a line originating at the northern base of the Oceanic Bridge at Locust Point, then bearing approximately 60 degrees T to a department maintained marker at the north easternmost point of land at the mouth of Claypit Creek, then following the shoreline in an easterly direction to a department maintained marker at the south easternmost point of land at lower Rocky Point, and continuing on a line bearing approximately 146 degrees T to the southernmost white obstruction buoy, then continuing to the north easternmost point of land on the first adjacent unnamed island, then continuing to the northeast tip of the second adjacent unnamed island, then along the eastern shoreline to the south easternmost point, then to a department maintained marker on the north easternmost point of land on the adjacent third unnamed island, then following the eastern shoreline to a department maintained marker on the southern shoreline, then along a line bearing 174 degrees T to a department maintained marker, then bearing 244 degrees T across the mouth of an unnamed creek, then continuing along the shoreline to a department maintained marker at the end of Navesink Avenue, then following a line across Black Point Creek bearing 280 degrees T to the southeasterly point of land on Barley Point Island, then following the shoreline in a northwesterly direction to a Department</u>

maintained marker on the westernmost point of land on the island then along a line bearing 250 degrees T to a Department maintained marker on a point of land at the end of the Avenue of Two Rivers, then following the shoreline in a westerly direction to the southern base of the Oceanic Bridge, then along a line crossing the Oceanic Bridge and terminating at its northern base.

2. Coliform samples from the four upstream stations (series 1000) should be analyzed using the four tube dilution protocol to more accurately quantify the maximum levels in the upstream segment.

3. The potential sources of elevated coliforms during dry weather at stations 1004D, 1007, 1014, and1014D should be further investigated to determine the origin of the bacterial contamination and/or the potential of one or more unpermitted discharges.

4. The implementation of Best Management Practices (BMP's) to control nonpoint pollution from urbanization, agriculture and marina/boating activities in the Navesink watershed should be strengthened, in an effort to further reduce bacterial pollution to the point where unrestricted shellfish harvesting throughout the river may occur in the future.

5. Strengthen rules governing new development/construction (CAFRA and Waterfront Development permits) in the Navesink watershed as a whole, with emphasis along the shoreline, where the effect of pollutant discharge is direct and the impact is immediate. In order to protect shellfish and the public health from the effects of nonpoint source pollution, the NJDEP has begun the process to designate the Navesink (and adjoining Shrewsbury River) as a "Special Water Area", as provided in N.J.A.C. 7:7E-3.1, "Rules on Coastal Zone Management".

6. In order to protect shellfish and the public health from the effects of nonpoint source pollution in the Navesink (and the adjoining Shrewsbury River), the NJDEP, Monmouth County and its municipalities should review and evaluate the feasibility of establishing the first "Shellfish Protection District" in New Jersey. As has been recently implemented in a few other states, these districts could be coordinated at the county/municipal level and could develop regional stormwater management and nonpoint source management plans and ordinances. The regional agencies could work with various NJDEP and USEPA programs (Stormsewer Infrastructure Improvement Act, New Jersey Wastewater trust, State Nonpoint Source Program) to secure long term cost-shared funding for future stormwater management implementation. Using the Navesink and Shrewsbury rivers as a prototype, the NJDEP should encourage and support new legislation establishing "shellfish protection districts" in New Jersey. As has been done in other states, the legislation allows counties with shellfish growing areas to fund practical programs to control nonpoint source pollution. Counties will be able to create districts to

finance shellfish protection programs through county tax revenues, inspection fees, states grants or loans, as specified in each county's shellfish protection program.

7. Since the Shrewsbury River is hydrologically connected to the Navesink River, and has been shown through hydrographic analysis to be capable of exerting a profound effect on the downstream section of the Navesink, it would be prudent to formally include the Shrewsbury River in the Navesink Nonpoint Source Protection Program. The NJDEP has informally included the Shrewsbury as part of the overall Navesink protection program, particularly when reviewing CAFRA and Waterfront Development permit applications.

8. In order to further assess pollutant source loadings (from urban/suburban development, agriculture and marina/boating activities) to the Navesink River, funding should be sought to conduct a comprehensive modeling study and develop a watershed management plan for the entire Navesink watershed. The outcome of such an investigation would assist the NJDEP and the cooperating agencies participating in the Navesink River Shellfish Protection Program in refining the type and location of existing or proposed Best Management Practices (BMP's) implemented throughout the watershed.

Figure 12 shows the proposed classification changes for the Navesink River.

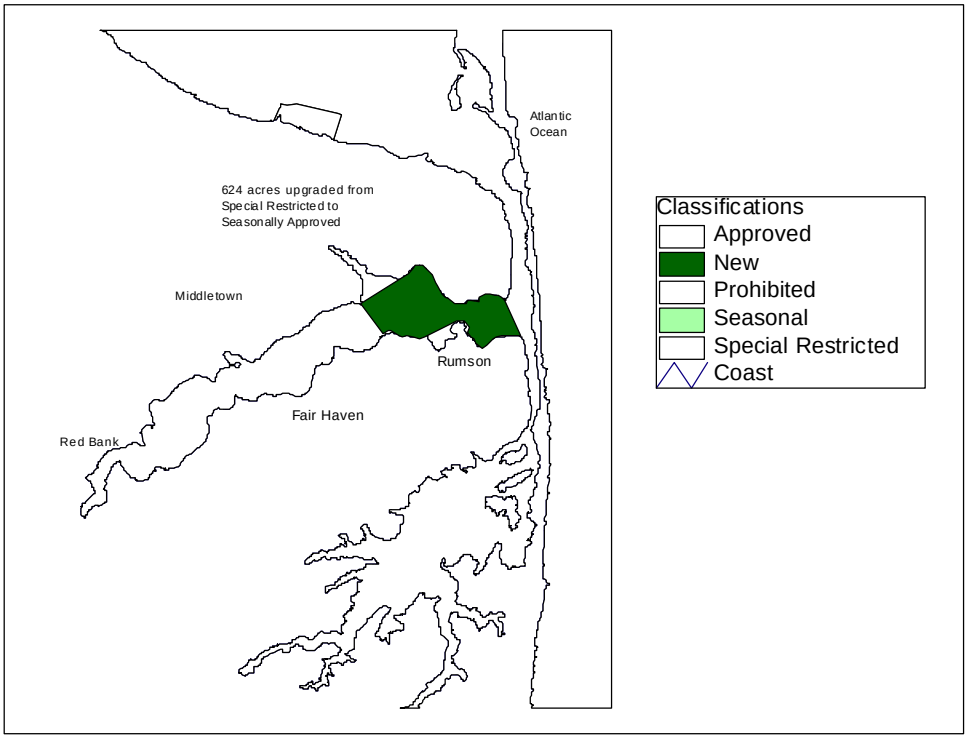


Figure 12: Proposed Shellfish Classification Changes for the Navesink Estuary. The Department proposes to upgrade 624 acres between the Oceanic Bridge and the Shrewsbury River from Special Restricted to Seasonally Approved.

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APPENDICES

A. Statistical Summaries

- Yearround
- Winter Only
- Summer Only

B. Seasonal Evaluation

C. Precipitation

- Rainfall Correlation
- Cumulative Rainfall
- Wet Weather Statistical Summary
- Dry Weather Statistical Summary

D. Tidal Evaluation

E. Data Listing - 1992 through 1995